Dec. 18, 1934. A. L. BRIDGHAM 1,984,359

DEVICE FOR PRODUCING AIR BLASTS OR SUCTION

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Fig. 1

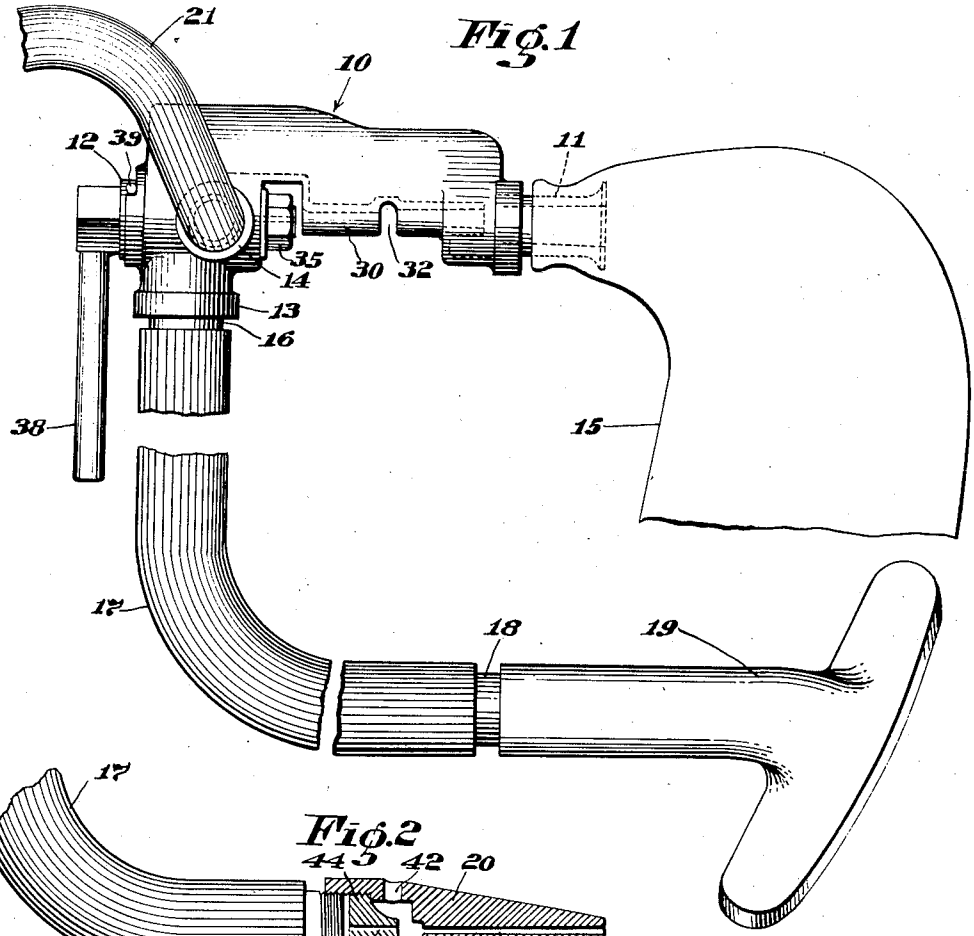


Fig. 2

Fig. 6

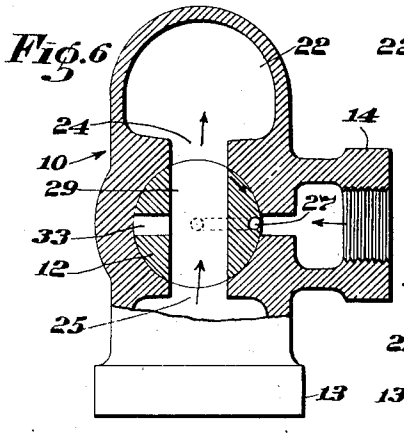
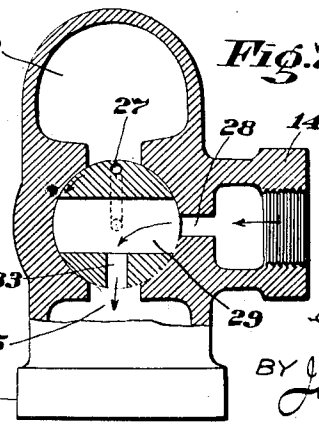


Fig. 7



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DEVICE FOR PRODUCING AIR BLASTS OR SUCTION

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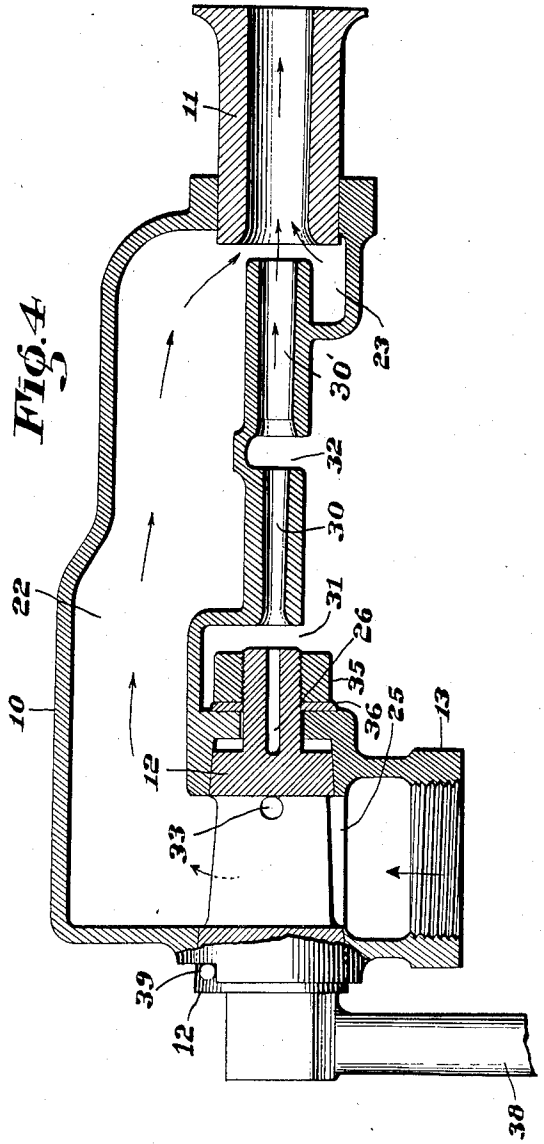


Fig. 4

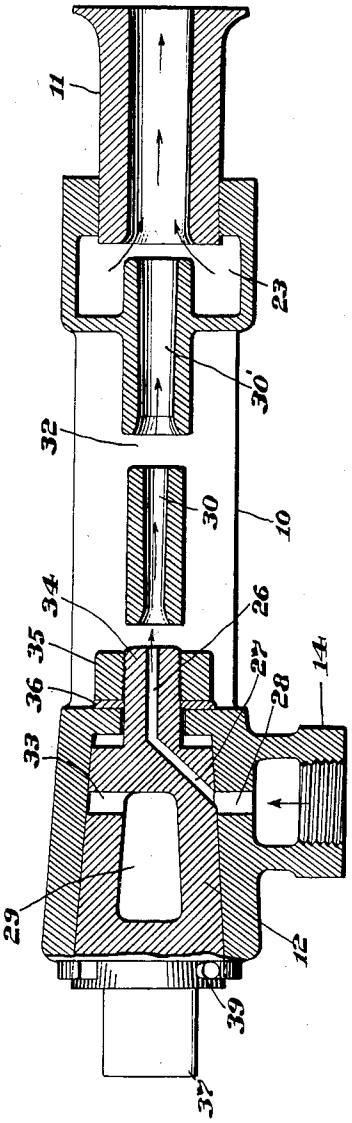


Fig. 5

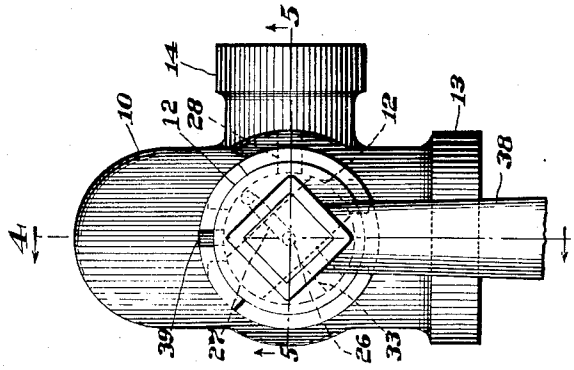


Fig. 3

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Patented Dec. 18, 1934 1,984,359

UNITED STATES PATENT OFFICE

1,984,359

DEVICE FOR PRODUCING AIR BLASTS OR SUCTION

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Application August 1, 1933, Serial No. 683,175

4 Claims. (Cl. 230—95)

The invention relates to improvement in devices for producing air blasts or suction in which compressed air or equivalent gaseous fluid is the initial moving force.

Compressed air controlled and directed to issue in the form of a blast or jet has manifold uses. It is highly desirable that economies be effected in the amount of compressed air used for obtaining any objective result both from the standpoint of excessive drain on the source of the compressed air and also from the standpoint of expense, for the compression of air oftentimes entails the use of considerable power and equipment.

The essential object of the invention is accordingly conservation in the amount of compressed air used for obtaining any objective result. More specifically the object of the invention is to provide means whereby atmospheric air may supplement compressed air in producing air blasts or suction and in a manner whereby the amount of compressed air used for obtaining the objective result is very small as compared with that previously used for obtaining the same result.

The invention is shown in connection with a vacuum apparatus to which it is applicable and exhibits in this connection various novel features of air control in which the air is used either for producing suction or as a blast at the will of the operator; also novel features in valvular structure, in nozzle structure, and in combinations, all of which can best be seen or understood by reference to the drawings, in which

Fig. 1 is a view substantially in side elevation of a vacuum cleaner equipped with a device embodying features of the present invention.

Fig. 2 is a sectional view through a blast nozzle constructed in accordance with the present invention.

Fig. 3 is an end view of the device of Fig. 1 with the valve portions thereof in the closed position.

Fig. 4 is a sectional view taken on the line 4—4 of Fig. 3 with the valve in the vacuum forming position.

Fig. 5 is a sectional view taken on the line 5—5 of Fig. 3 with the valve in the vacuum forming position.

Fig. 6 is a transverse sectional view through the valve mechanism of Fig. 4, and

Fig. 7 is a view similar to Fig. 6 with the valve in the blast forming position.

The vacuum cleaner illustrated is of the type in which a blast or jet of air is utilized to produce the operating suction, and is designed more particularly for use in cleaning cars. The cleaner may be operated from the supply of compressed air commonly available in railroad yards. It embodies as its new and essential feature a device whereby either a blast or suction may be employed to remove dirt and dust and this device will now be described.

The device shown comprises an elongated casing 10 having an air discharge pipe 11 at one end and a tapered valve 12 at its opposite end. The casing 10 is also provided with an inlet extension 13 through which air is supplied to the casing by suction, and an inlet extension 14 through which air under pressure is supplied to the casing.

The pipe 11 serves to discharge the dirt and air from the vacuum cleaning operation and is shown as provided with the usual dirt receiving bag 15, the neck of which is secured to the pipe 11. The inlet extension 13 is internally threaded and has connected thereto by the threaded nipple 16 the flexible vacuum cleaning tube 17. The opposite end of the tube 17 has a threaded nipple 18 adapted to receive the suction or vacuum cleaning nozzle 19 of any well known or desired construction.

Should it be desired to remove the dirt or dust by a blast of air rather than by a suction operation, then the suction nozzle 19 may be disconnected from the tubes 17 and the blast nozzle 20 of Fig. 2 employed in place thereof, whereupon the valve 12 may be adjusted in a manner to be described to supply air under pressure to the tube 17 and nozzle 20.

Air under pressure is supplied to the casing 10 from any suitable source of supply by the flexible pipe 21 leading to the inlet extension 14, and the means for employing this compressed air to produce a suction action within the casing 10 will now be described.

The conical valve 12 lies in axial alignment with the air discharge pipe 11 and communicates with this pipe by a relatively large conduit or vacuum chamber 22 disposed at one side of the axis of the aligned valve and pipe. The conduit 22 terminates at one end in the annular chamber 23 forming a part of the vacuum chamber and which encircles the inner end of the discharge pipe 11, and the conduit communicates at its other end with aligned openings 24, 25 leading to the extension 13. The communication between the openings 24 and 25 is controlled by the valve 12.

The valve 12 may be regarded as a nozzle valve since it is provided at its axis with a small bore

or nozzle 26 which receives air under pressure from the inlet extension 14 through the inclined bore 27 formed in the valve and positioned to communicate with a port 28 at the inner end of the extension 14. The arrangement is such that when the valve 12 is turned to the position in which it is shown in Figs. 4, 5 and 6 air under pressure will be supplied to the nozzle 26, and the passage 29 formed transversely of the valve 12 will form a communication between the extension 13 and vacuum chamber 22, as indicated by the arrows.

The desired suction is produced in the conduit 22 and tube 17 by directing a stream of air through the discharge pipe 11 with a suction action, and in accordance with the present invention this stream of air is formed in part of the compressed air supplied by the pipe 21 and in part by air from the atmosphere that is drawn into the path of the air jet produced by the nozzle 26.

The air from the atmosphere that supplements the air jet supplied by the nozzle 26 should be so united with this jet that the velocity of the latter will be imparted to the entire stream of air, and to accomplish this an aligned air combining nozzle is provided between the intake end of the pipe 11 and the discharge end of the compressed air nozzle 26. This air combining nozzle is shown as formed of the sections 30 and 30'. The air pressure nozzle 26 may be regarded as a primary discharge nozzle while the nozzle sections 30 and 30' may be regarded as secondary discharge nozzles.

The discharge end of the nozzle section 30' lies within the vacuum chamber 23 in spaced relation to the inner end of the pipe 11 and co-operates therewith to form an ejector that exhausts air from the vacuum chamber. The intake end of the nozzle section 30 is spaced from the primary nozzle 26 to provide the air space 31 for supplying air from the atmosphere to the air combining nozzle. In order to supply additional atmospheric air to the stream of air passing through the air combining nozzle, the air space 32 is provided for introducing air into the intake end of the nozzle section 30'.

The bore of the nozzle 30, 30' is preferably tapered as shown to cause it to increase progressively in size so as to facilitate the rapid passage of the air stream therethrough and the introduction of the supplemental air from the atmosphere into the nozzle, and the bore of each section 30 and 30' has a contracted neck with converging and diverging walls leading respectively thereto and therefrom as shown.

The arrangement is such that as the jet of compressed air from the nozzle 26 enters the nozzle section 30 it draws atmospheric air into the latter from the opening 31 and imparts its rapid movement to this atmospheric air to form a larger stream of rapidly moving air. This stream of air is further supplemented by the atmospheric air that enters the section 30' from the opening 32. The stream of rapidly moving air thus formed is directed by the discharge end of the nozzle section 30' through the air discharge pipe 11 with an ejector action to exhaust air from the vacuum chamber 23.

It is important that the proper relation between the size of the bores of the different nozzles is maintained and that they increase in size progressively in the direction in which the air travels therethrough, so that the air from the atmosphere supplied to supplement the jet of compressed air will be driven rapidly through the nozzle sections 30 and 30' by the compressed air.

As a result of the construction just described a small jet of compressed air supplied by the bore 26 serves to provide a much larger jet of air driven through the pipe 11 to produce the desired suction action. In this manner a small quantity of compressed air serves to produce the desired vacuum, and a pronounced saving in compressed air results.

If the construction of the present invention is used to operate a vacuum cleaner the following dimensions will give excellent results. The bore of the nozzle 26 is ⅛''; the diameter of the throat of the nozzle section 30 is ¼'' and that of the throat of the nozzle section 30' is ⅜''. The bore of the pipe 11 is ½''.

The saving of compressed air obtained by employing a device of the present invention having the dimensions just mentioned was clearly shown by the following simple experiment. A metal plate was placed across the mouth of the inlet extension 13 so that the suction within the casing 10 would hold the plate in place. It was found that if the air inlets 31 and 32 were closed so as to exclude air from the atmosphere from the nozzle 30, 30' the metal plate would not be held in place by the suction, if the pressure of the air supplied by the pipe 21 fell below 100 pounds, but if the openings 31 and 32 were uncovered then the plate covering the port 13 would not drop until the pressure in the pipe 21 dropped to below 14 pounds. This indicates a saving of more than 75%.

When the suction tube 17 has the blast nozzle of Fig. 2 attached thereto in place of the suction nozzle 19 then air under pressure is supplied to the tube 17 by turning the valve 12 to the position in which it is shown in Fig. 7. Rotation of the valve to this position cuts off the supply of compressed air to the nozzle 26 since it moves the passage 27 out of alignment with the port 28. It also closes the communication between the inlet extension 13 and conduit 22 by turning the passage 29 out of communication with the openings 24 and 25. When the valve is in this position air under pressure passes from the extension 14 through the port 28 into the valve passage 29, and it escapes from this passage through a port 33 of the valve to the extension 13 and tube 17, as indicated by the arrows in Fig. 7.

The valve 12 is provided at its inner end with a reduced spindle 34 that is threaded to receive a nut 35 for holding the valve in place in the casing, and a washer 36 is provided between the casing wall and nut 35. The valve 12 is provided at its outer end with a projection 37 adapted to have secured thereto the operating handle 38. When the handle is positioned as shown in Fig. 3 the port 28 is closed and the device is out of operation. If the handle is shifted to the left in Fig. 3 suction will be produced in the tube 17, and if the handle is shifted to the right a blast of air will be supplied to the tube 17. The shifting movement of the valve is limited by the stop pin 39.

The blast nozzle 20 of Fig. 2, like the suction producing means above described, is designed to conserve compressed air, and to this end uses atmospheric air to supplement the jet of compressed air. This is accomplished in the device shown by so constructing the blast nozzle 20 that a space or chamber 40 is provided at the inner end of the bore 41 of the nozzle. The chamber 40 communicates with the atmosphere through an opening 42 in a side wall of the nozzle casing. The construction is such that a jet of compressed air is directed across the air space 40 into the bore 41

by a smaller nozzle 43 formed within a threaded member 44 screwed in the threaded bore of the nozzle casing. The jet of air entering the bore or nozzle 41 draws air from the atmosphere into this bore to form a much larger jet of rapidly moving air, thereby securing a saving in the amount of compressed air used.

While the construction of the present invention for conserving compressed air in producing either a blast or suction has been shown and described in connection with a vacuum cleaner, the invention may obviously be employed for other purposes.

Having thus fully described my invention, I claim and desire to secure by Letters Patent of the United States:

1. A pneumatic suction producing device comprising a casing having a vacuum chamber and an air discharge pipe leading from said chamber, a primary and secondary nozzle, the bore of said secondary nozzle being larger than that of said primary nozzle, said nozzles being arranged in axial alignment and having an air space between them open to the entry of air at atmospheric pressure, and the secondary nozzle being so arranged that its discharge end extends into said vacuum chamber in alignment with said discharge pipe to form an ejector that exhausts air from said chamber, and means for supplying air under pressure to said primary nozzle to cause it to direct a jet of air across said space between the nozzles into the secondary nozzle whereby said jet will be amplified by air from the atmosphere to form a larger stream of air discharge from the secondary nozzle into said pipe with a suction action that exhausts air from said chamber.

2. A pneumatic suction producing device comprising a casing having a vacuum chamber and an air discharge pipe leading from said chamber, a primary nozzle and a plurality of secondary nozzles, said nozzles having bores increasing progressively in size, said nozzles being arranged in axial alignment with air spaces between them open to the entry of air at atmospheric pressure, and the foremost one of said secondary nozzles being so arranged that its discharge end extends into said vacuum chamber in alignment with said discharge pipe to form an ejector that exhausts air from said chamber, and means for supplying air under pressure to said primary nozzle to cause it to direct a jet of air through said secondary nozzles and across the spaces between said nozzles whereby said jet will be amplified by air from the atmosphere to form a larger stream of air discharge from the outermost one of the secondary nozzles into said pipe with a suction action that exhausts air from said chamber.

3. A pneumatic suction producing device, comprising a casing having a vacuum chamber and an air discharge pipe leading from said chamber, a nozzle having its discharge end extending into said chamber in alignment with said pipe to form therewith an ejector that exhausts air from the chamber, and means for directing a jet of air into said nozzle so that it will draw air from the atmosphere into the nozzle at a point outside said chamber to form a larger stream of air discharged from said nozzle into said pipe with a suction action that exhausts air from the chamber.

4. A suction and blast producing device comprising a casing having a vacuum chamber and an inlet for admission of air under pressure, a tube leading from said casing, means for creating a vacuum within said chamber including a nozzle through which air under pressure is directed to pass, a valve arranged to turn in said casing located between said vacuum chamber and said tube, said valve having passages within it adapted and arranged whereby for a determinate turned position of said valve communication will be closed between said inlet and said nozzle and between said inlet and said tube, and for another turned position of said valve said valve will close communication between said inlet and said tube and open communication between said inlet and nozzle and between said vacuum chamber and tube, and for another turned position of said valve said valve will close communication between said inlet and said nozzle and between said vacuum chamber and said tube and will open communication between said inlet and said tube.

ARTHUR L. BRIDGHAM.